CLAIMS

1. A method for modifying an audio signal comprising a plurality of channel signals, the method comprising:

    transforming at least selected ones of the channel signals into a time-frequency domain;

    comparing said at least selected ones of the channel signals in the time-frequency domain to identify corresponding portions of said channel signals that are not correlated or are only weakly correlated across channels; and

    modifying the identified corresponding portions of said channel signals.

2. The method of claim 1, further comprising defining a metric the value of which is determined for any set of corresponding portions of said channel signals at least in part by the degree of correlation between them.

3. The method of claim 2, wherein the metric comprises calculating a correlation value.

4. The method of claim 2, wherein the metric comprises calculating a coherence value.

5. The method of claim 4, wherein calculating a coherence value comprises using a coherence function, the value of which is approximately equal to one for portions of said channel signals that are highly correlated.

6. The method of claim 4, wherein calculating a coherence value comprises a coherence function, the value of which is approximately zero for portions of said channel signals that are uncorrelated or only weakly correlated.

7. The method of claim 4, wherein calculating a coherence value comprises using a coherence function, the value of which is a positive number slightly greater than zero for portions of said channel signals that are uncorrelated or only weakly correlated.

8. The method of claim 2, wherein corresponding portions of said channel signals are identified as not correlated or only weakly correlated if the value of the metric is less than a prescribed threshold.

9. The method of claim 1, wherein modifying the identified corresponding portions of said channel signals comprises applying a modification function, the value of which for any set of corresponding portions of said channel signals is determined at least in part by the degree of correlation between them.

10. The method of claim 9, wherein the modification function comprises a nonlinear function applied in the time-frequency domain.

11. The method of claim 9, wherein the modification function comprises a hyperbolic tangent function applied in the time-frequency domain.

12. The method of claim 9, wherein modifying the identified corresponding portions of said channel signals comprises multiplying each of said channel signals in the time-frequency domain by a corresponding modification function value.

13. The method of claim 12, wherein the modification function has a value equal to approximately one for portions of said channel signals that are not to be modified.

14. The method of claim 12, wherein the modification function has a value other than one for portions of said channel signals that are to be modified.

15. The method of claim 12, wherein the modification function has a value equal to approximately one for portions of said channel signals that are to be extracted and a value equal to approximately zero for portions of said channel signals that are not to be extracted.

16. The method of claim 9, wherein for portions of said channel signals that are to be modified the value of the modification function is determined at least in part by a user input.

17. The method of claim 16, wherein the user input determines at least in part the value of a scaling factor by which the modification function values are multiplied.

18. The method of claim 16, wherein the user input determines at least in part the value of a parameter comprising part of the modification function.

19. The method of claim 18, wherein the parameter determines at least in part a maximum value for the modification function.

20. The method of claim 18, wherein the parameter determines at least in part a minimum value for the modification function.

21. The method of claim 16, wherein the user input defines at least in part a bandwidth within which the modification will be performed.

22. The method of claim 1, wherein the step of modifying comprises modifying the identified portions of the audio signal only within a prescribed frequency band.

23. The method of claim 22, wherein the prescribed frequency band is determined at least in part by an indication received from a user.

24. The method of claim 1, wherein the step of modifying comprises:

determining for each channel an input ratio in which the numerator comprises a measure of said portions of the channel signal that are uncorrelated or weakly correlated and the denominator comprises a measure of the overall channel signal;

receiving a user input indicating a desired output ratio of uncorrelated or weakly correlated portions to total signal; and

applying to said portions of said channel signals that are uncorrelated or weakly correlated a modification factor calculated to modify the channel signals as required to achieve the desired output ratio indicated by the user.

25. The method of claim 24, wherein determining for each channel an input ratio comprises:

extracting the uncorrelated or weakly correlated portions from the overall signal;

determining the energy level of the uncorrelated or weakly correlated portions;

determining the energy level of the overall signal; and

dividing the energy level of the uncorrelated or weakly correlated portions by the energy level of the overall signal.

26. The method of claim 25, wherein the modification factor comprises the square root of the result obtained by dividing the user-indicated ratio by the input ratio.

27. The method of claim 1, wherein transforming at least selected ones of the channel signals into a time-frequency domain comprises processing said channel signals using a subband filter bank.

28. The method of claim 27, wherein processing said channel signals using a sub-band filter bank comprises calculating the short-time Fourier transform (STFT) of said channel signals.

29.   The method of claim 1, further comprising processing said modified corresponding portions of said channel signals to synthesize a modified time-domain signal.

30.   The method of claim 29, wherein transforming at least selected ones of the channel signals into a time-frequency domain comprises calculating the short-time Fourier transform (STFT) of said channel signals and wherein processing said modified corresponding portions of said channel signals to synthesize a modified time-domain signal comprises performing the inverse STFT on said signals.

31.   A method for modifying an audio signal comprising a plurality of channel signals, the method comprising:

        transforming at least selected ones of the channel signals into a time-frequency domain;

        comparing said at least selected ones of the channel signals in the time-frequency domain to determine the extent to which corresponding portions of said channel signals are correlated across channels; and

        modifying the corresponding portions of said channel signals based on the extent to which said corresponding portions of said channel signals are correlated across channels.

32.   The method of claim 31, wherein modifying the corresponding portions of said channel signals based on the extent to which said corresponding portions of said channel signals are correlated across channels comprises a nonlinear modification.

33.   The method of claim 31, wherein modifying the corresponding portions of said channel signals based on the extent to which said corresponding portions of said channel signals are correlated across channels comprises calculating a cross channel coherence value.

34.   A method for providing a generated signal to a playback channel of a multichannel playback system, the method comprising:

        receiving an input audio signal comprising a plurality of input channel signals;

transforming at least selected ones of the input channel signals into a time-frequency domain;

comparing said at least selected ones of the input channel signals in the time-frequency domain to identify corresponding portions of said input channel signals that are not correlated or are only weakly correlated;

extracting from each of said input channel signals the identified corresponding portions of said input channel signals that are not correlated or are only weakly correlated;

combining the extracted portions; and

providing to the playback channel a signal comprising at least in part said extracted and combined identified corresponding portions of said input channel signals that are not correlated or are only weakly correlated.

35. The method of claim 34, wherein combining the extracted portions comprises taking the difference between the corresponding extracted portions.

36. The method of claim 34, wherein the playback channel comprises a first playback channel and further comprising providing to at least one additional playback channel a signal comprising at least in part said extracted and combined identified corresponding portions of said input channel signals that are not correlated or are only weakly correlated.

37. The method of claim 36, further comprising decorrelating the signal provided to said first playback channel and the signal provided to said at least one additional playback channel.

38. The method of claim 37, wherein decorrelating the signal provided to said first playback channel and the signal provided to said at least one additional playback channel comprises processing the signal provided to each respective playback channel using an allpass filter configured to apply a phase adjustment that is different than the phase adjustment applied to the respective signals provided to the other playback channel(s).

39. The method of claim 37, wherein decorrelating the signal provided to said first playback channel and the signal provided to said at least one additional playback

channel comprises processing the signal provided to each respective playback channel using a delay line configured to apply a delay that is different than the delay applied to the respective signals provided to the other playback channel(s).

40. The method of claim 34, further comprising modifying the extracted and combined portions prior to providing them to the playback channel.

41. The method of claim 40, wherein the modification is determined at least in part by a user input.

42. The method of claim 41, wherein the user input determines at least in part the gain of an amplifier used to process the extracted and combined portions.

43. The method of claim 41, wherein the user input determines at least in part a bandwidth within which the modification is performed.

44. The method of claim 43, wherein the bandwidth is implemented by processing the extracted and combined portions using a bandpass filter and the user input determines at least in part the lower and upper boundary frequencies of the bandpass filter.

45. The method of claim 34, wherein the steps of extracting and combining comprise determining the magnitude of the respective portions of said input channel signals that are not correlated or are only weakly correlated, taking the absolute difference of the magnitude values, and applying the phase of one of the input channels to the result.

46. The method of claim 34, wherein the input audio signal comprises an input signal for the playback channel and wherein the signal provided to the playback channel comprises at least in part the input signal received for the playback channel.

47. The method of claim 46, wherein the signal provided to the playback channel comprises at least in part the input signal received for the playback channel combined with the extracted and combined identified corresponding portions of said input channel signals that are not correlated or are only weakly correlated.

48. A system modifying an audio signal comprising a plurality of channel signals, the method comprising:

an input connection configured to receive the audio signal; and

a processor configured to:

transform at least selected ones of the channel signals into a time-frequency domain;

compare said at least selected ones of the channel signals in the time-frequency domain to identify corresponding portions of said channel signals that are not correlated or are only weakly correlated across channels; and

modify the identified corresponding portions of said channel signals.

49. A computer program product for modifying an audio signal comprising a plurality of channel signals, the computer program product being embodied in a computer readable medium and comprising computer instructions for:

transforming at least selected ones of the channel signals into a time-frequency domain;

comparing said at least selected ones of the channel signals in the time-frequency domain to identify corresponding portions of said channel signals that are not correlated or are only weakly correlated across channels; and

modifying the identified corresponding portions of said channel signals.